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EXPERIMENTS ON THE COMPARATIVE VALUE OF VARIOUS ANTISEPTICS IN THE TREATMENT OF DISEASED TEETH.

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IT is a fact familiar to every practitioner of dentistry that the complete removal of the remains of a necrotic pulp from its canal is often accompanied by very great, if not by practically insurmountable, difficulties.

While it is a comparatively easy task to cleanse the canals of the upper front teeth, and one which usually may be accomplished to the complete satisfaction of the operator, the bicuspids often put our skill and endurance to the severest test, and few operators would have the hardihood to claim that they can always thoroughly cleanse the canals of the buccal roots of the upper or of the mesial root of the lower molars with any degree of certainty. In fact, I do not at all hesitate to say that in the majority of cases these roots are very imperfectly cleansed, even by those who claim to have attained to perfection in this branch of operative dentistry.

In all such cases where remains of necrotic or decomposing pulp-tissue are left in the root-canals at the time of filling, it becomes the object and duty of the operator to so impregnate them by the application of the antiseptic most suitable for the purpose as to reduce the possibility of their subsequent putrefaction to a minimum.

I have no doubt that the great majority of dentists who are willing to be perfectly candid will confess to having repeatedly, knowingly, left considerable portions of narrow, contorted root-canals uncleansed after pumping into them some antiseptic with the finest possible nerve-broach, without at the same time departing from the principle that,

when at all possible or judicious, the last trace of the pulp should be removed before filling.

Some eight years ago, Telschow* advanced the idea that the removal of the devitalized pulp is an unnecessary torture and trouble. He claimed to be able, by boring into the pulp-chamber and applying a certain mixture to the pulp, to prevent its subsequent decomposition, or even to arrest the decomposition when it had already set in. The mixture recommended by Telschow was nothing other than a modified form of the well-known Wickersheimer fluid, by the *injection* of which corpses of animals (fishes, snakes, monkeys, etc.) may be kept indefinitely in a fresh condition. Telschow overlooked the fact that there is a vast difference between *injecting* a substance and applying it superficially to one end of an elongated body. If he had tried the experiment of putting a pledget of cotton saturated with Wickersheimer fluid in the snake's mouth, he would then have had an analogon of the operation which he recommends for the human tooth-pulp.

Nevertheless, exceedingly favorable results were reported from the use of the Wickersheimer fluid. Six years later, Baume ("Ein neues Princip der antiseptischen Behandlung devitalisirter Pulpen durch Imprägnirung mit Salzen," *Deutsche Monatsschrift für Zahnheilkunde*, März, 1888) recommended the same method of treatment, making use of alum and borax instead of Wickersheimer fluid. He reports having treated over two hundred pulps, devitalized with arsenic, with these salts without a single failure.

Personally I had no faith whatever in the treatment with Wickersheimer fluid, and very little in the treatment with borax, and consequently have made no use of either of these materials in my practice or in the clinic of the dental institute. In cases where I for any reason have not accomplished the complete extraction of the pulp, I have preferred to use stronger antiseptics than either of the above mentioned.

If we ask the question, Which of the many antiseptics found in the dental materia medica is best adapted to prevent decomposition either of inextricable pulp-remains or of whole pulps? we will obtain answers which will convince us that the greatest diversity of opinion exists in regard to this question. Creasote, carbolic acid, salicylic acid, thymol, bichloride of mercury, chloride of zinc, trichlorphenol ($C_6H_2Cl_3OH$), tincture of iodine, iodoform, naphthaline, peroxide of hydrogen, sozoiodol, oil of eucalyptus, β-naphthol, hydronaphthol, campho-phenique, carbonate of soda, and the ethereal oils are by no means all of the agents which have been recommended and used "with the greatest success" in the antiseptic treatment of root-canals.

* Ein neues antiseptisches Verfahren zur Erhaltung cariöser Zähne.

Finally, it has been claimed that the agents upon which we have placed so much reliance—sublimate, carbolic acid, etc.—are not only useless but detrimental in the treatment of pulpless teeth ; and furthermore, that the object in view can be accomplished quite as well with distilled water as with any of the antiseptics named. In fact, the opinions of the dental profession at present regarding antiseptics may be said to be in a state of utter chaos,—a fact which may be readily accounted for, I think, on the following grounds :

In attempting to assign the success or failure of operations upon diseased teeth to their proper causes, factors of the greatest importance are frequently left out of account, and the results ascribed to some agent which may have been entirely indifferent. One of these factors, often overlooked, which forms the very foundation of successful root-treatment, is the *manner* in which the mechanical cleansing of the canal is carried out.

The operator who thoroughly appreciates the nature of the organ upon which he is operating, and never forgets that the root of the human tooth forms a tube open at both ends,—who, equipped with the proper instruments, possesses sufficient patience, skill, and delicacy of manipulation to clear out the contents of the canal instead of forcing them farther in, will not have an undue number of failures to complain of with any antiseptic of moderate strength. It is also equally true that an operator whose clumsy instruments and unskillful fingers cleanse the canal only by forcing its contents through the apical foramen will have one failure after another, whatever antiseptic he may use. While now the successful operator attributes much of his success to the antiseptic used, the unsuccessful one attributes still more his failures to the same agent.

Again, those who have introduced new antiseptics to the profession have almost invariably had "wonderful success," no matter how worthless the antiseptic may have been. We must never forget that teeth whose pulps are devitalized with arsenious acid and filled immediately without any treatment whatever may remain perfectly quiet for weeks, months, or years, and sometimes never give any trouble.

The same is true to a certain degree of teeth whose pulps die under fillings. When we treat a tooth or a certain number of teeth by means of a given new antiseptic, and the teeth give no trouble after a few weeks or months, we still cannot say whether the apparent success is due to the medicament, or is independent of it, or has been accomplished in spite of it.

It has taken nearly ten years to find out that iodoform, which at the time of its introduction was believed to be quite equal to any task imposed upon it, is perhaps about one of the most worthless materials

ever introduced to the profession for the treatment of devitalized pulps or of root-canals. In short, the real value of any antiseptic may be clinically determined only after years of observation by many practitioners on large numbers of teeth.

At present the views of the profession are equally as much, if not more, divided on this point than they were five years ago, and it would be rather venturesome for anyone to promise that five years hence our clinical experience will have brought us much nearer a solution. In the mean time new antiseptics will constantly be recommended and employed with the customary "great success," which in many cases will subsequently, to the great inconvenience of the patient, turn out to be great failure.

It is accordingly my opinion that the question of the comparative value of the many different antiseptics in use may be solved much more easily and quickly, and with much less discomfort to the patient, in the laboratory than in practice.

It is, moreover, very doubtful whether the practitioner of dentistry is justified in making use of his patients as subjects of experiment upon which he tests various antiseptics before he has thoroughly convinced himself, by properly conducted experiments, that the substance which he is employing possesses properties which give every reason to hope that its use will be accompanied by good results.

For this reason I have undertaken a series of experiments which I take the liberty to present in the following pages. With the help of my pupil and friend, Carl Yung, I have made up to date 393 separate experiments, in which I tested the action of chloride of lime, oil of wintergreen, oil of peppermint, oil of cinnamon, chloride of zinc, iodoform, borax, boracic acid, salicylic acid, benzoic acid, thymol, carbolic acid, chlorphenol, α- and β-naphthol, hydronaphthol, campho-phenique, sozoiodol, Lister's new antiseptic, sulphate of copper, iodol, sulpho-carbolate of zinc, cyanide of mercury, resorcin, and many other antiseptics of more or less repute.

The object of the experiments was to determine *what antiseptic penetrates pulp-tissue most readily and deepest, and most effectually preserves it from decomposition.*

Methods of Experimentation.

For convenience of description my experiments may be arranged in five groups, determined by the manner in which the test was carried out. The different groups of experiments are in very different stages of completion. While those under Group I are far advanced, those in Group V are just begun, so that this report will require to be supplemented and probably in some points corrected by another which will follow later.

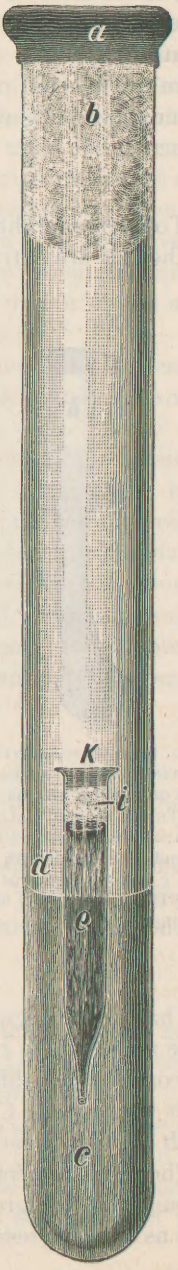
Group I.

The first permanent molar of the calf possesses at the time of eruption a pulp about one inch broad and half an inch thick, which divides at a quarter to a half inch from the base into five approximately conical columns which gradually taper toward the crown of the tooth. Four of these columns have a length of one and a quarter to one and a half inches; the fifth is much shorter and smaller. They represent separate centers of dentinification, and may be treated as separate pulps.

Having divided them at the base, we bring them into small glass tubes, flanged at one end and drawn out to a point at the other. Some difficulty will be experienced at first in getting the pulps nicely into the tubes, but anyone may soon overcome this. I tie a fine waxed silk thread around the pointed end of the pulp, moisten the latter with a drop of water, and then thread it into the tube; suction applied to the small end of the tube will also be found very effective.

These pulps are then infected, either at one or both ends or throughout, by bacteria obtained by stirring a number of freshly extracted teeth in a small quantity of water. Finally, the antiseptic to be tested is applied to the pulp at the larger end, covered with cotton, and the tube closed with melted wax. This tube with the pulp is then brought into a test-tube containing nutritive agar-agar, and the point made to extend considerably below the surface of the agar (Fig. 1); the tube is then closed with cotton in the ordinary manner, provided with a rubber cap, and placed in the incubator.

FIG. 1.*



Group II.

I made use also of the incisor and cuspid teeth of the calf, not, however, as a rule removing the pulps from the teeth, but simply

* FIG. 1.—ARRANGEMENT FOR TESTING THE ACTION OF ANTISEPTICS ON THE DENTAL PULP. *a*, rubber cap; *b*, cotton stopper; *c*, nutritive agar-agar; *d*, glass tube containing the pulp; *i*, cotton carrying or covering the antiseptic; *k*, wax.

boring into them from the lingual surface, applying the antiseptic, and closing the opening with wax.

This method did not give as satisfactory results as the former. The large size of these pulps, and particularly the wide foramen, seemed especially to favor the progress of the putrefactive process from the infected part toward the crown, so that the test proved too severe for nearly all of the antiseptics employed, except bichloride of mercury.

Group III.

To overcome the difficulty just referred to, the incisors and cuspids of the calf are extracted and freed from pericementum, and the root elongated by means of a short glass tube as represented in Fig. 2. A small opening is then made in the crown to represent an apical foramen and to admit of infecting the pulp. The antiseptic being applied through the glass tube, the whole is placed in a tube of nutritive agar-agar as explained above.

This method, which I have only begun to employ, appears so far to furnish very instructive results.

FIG. 2.

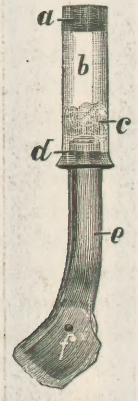


FIG. 2.—ARRANGEMENT FOR APPLYING ANTISEPTICS TO THE PULP OF THE INCISOR OR CUSPID TEETH OF THE CALF. *e*, tooth; *b*, glass tube fixed upon the end of the tooth with wax at *d*; *c*, cotton carrying or covering the antiseptic; *a*, wax; *f*, artificial foramen.

Group IV.

Freshly extracted human teeth whose pulps were not in a state of decomposition were likewise employed. The cavity was cleansed, the pulp-chamber freely opened, and the antiseptic applied to the pulp, covered with cotton, and the cavity closed with wax; liquids were of course applied on cotton. The further treatment was identical with that explained under Group I.

Group V.

I have just begun to experiment on the teeth of living dogs, but have no results to report at present. These experiments are attended by considerable difficulties, as the animals must be chloroformed at each operation. Cats are equally difficult to work upon, while the teeth of rabbits and guinea-pigs are not suitable for the purpose.

The employment of glass tubes in the manner described under Group I has the great advantage that the action of the antiseptic, as well as the progress of the putrefaction, is directly visible to the naked eye.

After the preparations had been in the incubator a length of time, varying from two days to many weeks, they were removed, the glass tubes cut across or the teeth split open, and the pulps carefully drawn out (their condition being minutely noted) and placed upon the surface of a plate of nutritive agar-agar. If the pulp was in a perfectly aseptic condition, or if it had taken up enough of the antiseptic to exert itself an antiseptic action, no bacteria developed around it; otherwise a portion of it or the whole, depending upon the strength and penetrating power of the antiseptic, would become enveloped in a growth of bacteria. No doubt the stereotyped objection may be made to these experiments that in the human mouth we do not have to treat pulps in glass teeth. Objections of this nature come principally from those who, in a dog-in-the-manger fashion, do not experiment themselves and feel called upon to growl at all who do.

The same objection might be urged with an equal show of reason against chemistry, physics, and allied sciences which study nature in glass tubes or within the four walls of a laboratory.

To a candid mind, however, it will appear that the decomposition of a tooth-pulp must take place in about the same manner in a tube of glass as in one of dentine, and an antiseptic which does not prevent a pulp from putrefying in the former cannot be depended upon for preserving it in the latter. Moreover, the experiments in Groups II to V are free from the glass objection, and finally approach so near to the conditions existing in the mouth that there can be no doubt of their practical value, particularly as the various methods have thus far yielded identical results.

Results.

I cannot attempt (nor would it be advisable to do so) to give the results of each of the three hundred and ninety-three experiments thus far made. They would fill some fifty pages of the Cosmos, and necessitate much labor on the part of the reader who would attempt to sift them out so as to get at the fundamental facts revealed by them. I shall therefore give only the general results obtained with different medicaments.

1. *Iodoform.*

Attention has been frequently called to the fact that iodoform is far from possessing the marked antiseptic properties formerly attributed to it. This assertion is fully affirmed by my experiments.

Pulps treated by methods I to IV were found in a few days to be in a state of partial decomposition, soft, and stinking; brought upon the culture plate, they very soon became surrounded by a thick, vigorous growth of bacteria, even at the very point where the iodoform had been applied.

It has been maintained that when products of putrefaction come into contact with iodoform iodine is set free, and that, accordingly, in such cases where decomposition has already begun, iodoform is particularly efficient in arresting it. To test the accuracy of this claim a pulp was infected and, after putrefaction had set in, rolled in powdered iodoform and put into a glass tube. After nine days, it was taken out and placed on an agar-agar plate, where in twenty-four hours it became completely overgrown with masses of bacteria (Fig. 3).

FIG. 3.

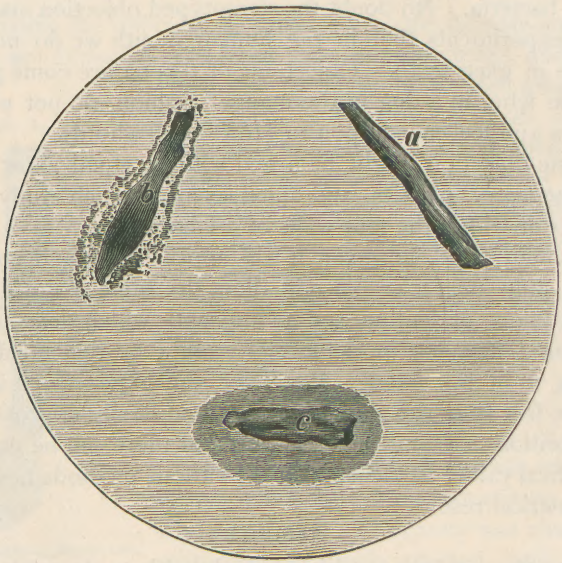


FIG. 3.—PLATE OF AGAR-AGAR WITH THREE PULPS. *a* had been treated with phenol; it remained sterile. *b* had been rolled in iodoform; it nevertheless soon became surrounded by a growth of bacteria. *c*, also treated with iodoform, is overgrown by micro-organisms.

I consider iodoform as one of the most worthless substances yet introduced for the purpose of treating the condition under consideration. That this fact has not been revealed by practical experience long ago is in part due to the circumstance that iodoform is nearly always employed in conjunction with some other material, such as carbolic acid, oil of cloves, etc.

2. *Chloride of Lime.*

This agent was employed in but two experiments; in these it so completely failed to manifest any retarding action upon the growth of bacteria in the pulps that it was discarded for further experiments.

3. *Peroxide of Hydrogen.*

Pulps treated with peroxide of hydrogen showed signs of putrefaction in from two to eight days, and on opening emitted an exceedingly

intense putrefactive odor. On plates of nutritive agar-agar they soon became overgrown with bacteria. This is just what we should expect; this agent brought into contact with the pulp soon decomposes, and becomes then absolutely inert. It may be advantageously employed for cleansing root-canals, but not for preserving non-extricable portions of pulp-tissue against future decomposition.

FIG. 4.

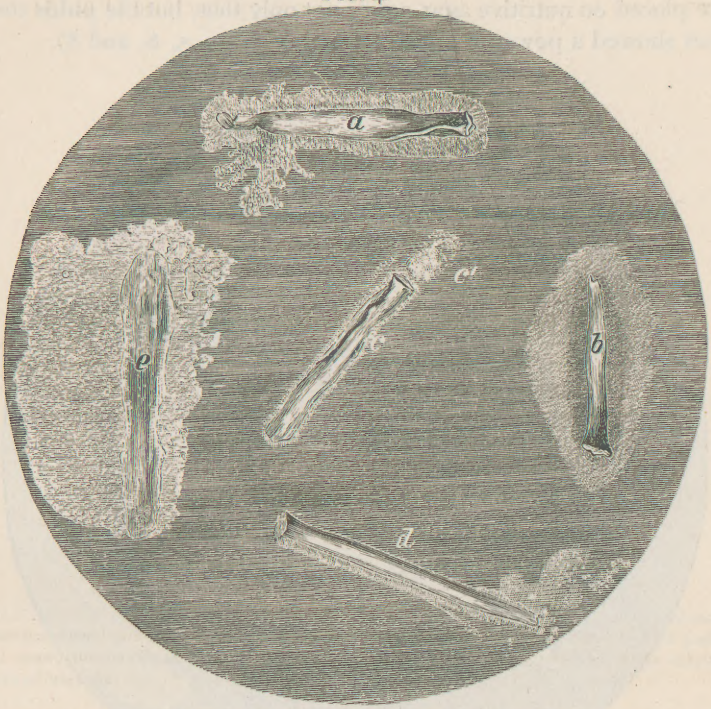


FIG. 4.—PLATE WITH PULPS FROM CALVES' TEETH. After treatment with β-naphthol (*a*), sulphate of copper (*b*), oil of peppermint (*c*) campho-phenique (*d*), sozoiodol (*e*). The whitish zone around *b* is due to a precipitate produced by the copper salt, and not to a growth of bacteria. At *c'* we see the cotton on which the oil of peppermint was applied also surrounded by a slight growth of bacteria. (In this illustration as well as in Fig. 8 the artist has made the agar-agar dark and the growths of bacteria light.)

4. *Sozoiodol Salts.*

The salts of sozoiodol (a derivative of carbolic acid, having the formula $C_6H_4I_2SO_4$) having lately, after the manner of all new antiseptics, received such unlimited praise for their antiseptic, non-poisonous, non-irritating, and altogether desirable qualities, have also begun to be introduced into the dental practice. Pulps treated with the potassium salt (kalium sozoiodolicum) showed no difference from those treated with water (Fig. 4, *e*). The sodium salt showed a slight action, hardly worthy of consideration.

5. *Bichloride of Mercury.*

Bichloride of mercury in powder, applied to the end of a pulp one and one-half inches long, permeated the whole pulp within forty-eight hours, converting it into a stiff gray mass. Such pulps removed from the tubes at any time from two days to eight weeks were completely preserved, without a trace of smell or any sign of decomposition. In no case did any development take place around the pulps when they were placed on nutritive agar-agar ; not only that, but the pulps themselves showed a powerful antiseptic action (Figs. 5, 6, and 8).

FIG. 5.

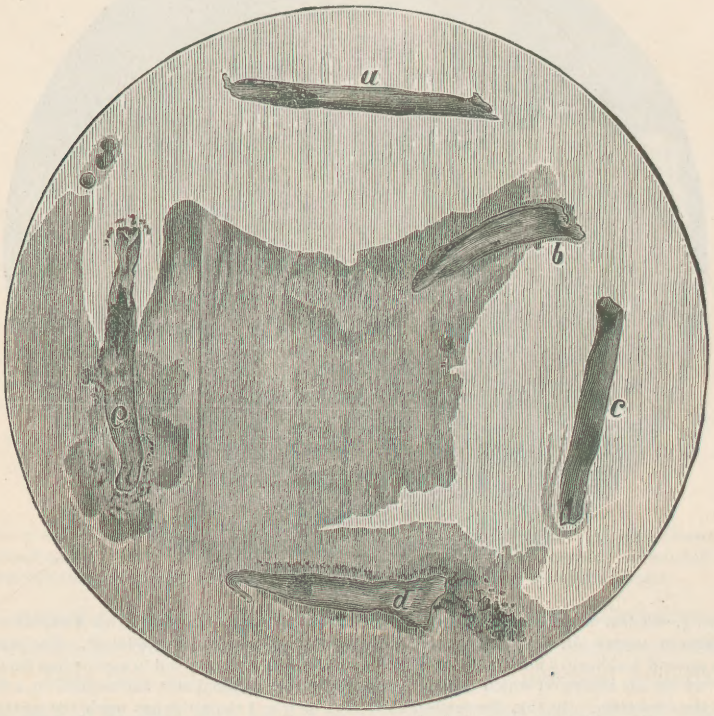


FIG. 5.—AGAR-AGAR PLATE WITH FIVE PULPS. *a* had been treated with sublimate, it remains completely sterile and no growth takes place near it ; *b* with oil of cinnamon, is pretty well surrounded by bacteria; *c* with chloride of zinc, remains sterile except at the point; *d* with borax, is completely overgrown; *e* with five per cent. solution of sublimate, the upper half only remains free.

The results obtained in Groups II to IV confirmed the above. I have no hesitancy in saying that the bichloride of mercury applied to the pulp in form of powder is by far the most efficient antiseptic which has as yet been employed to any extent in the treatment of the teeth. It has, however, the great disadvantage of seriously discoloring the teeth, so that it must be used with great caution, and never in form of powder be applied to the front teeth.

6. *Bichloride of Mercury, Five Per Cent. Solution.*

I was much disappointed in the action of the 5 per cent. solution of the bichloride of mercury. In glass tubes it permeated and preserved only about one-half of the length of the pulp, leaving the other half to decompose. When the pulps were placed on the plates of agar-agar, they likewise became enveloped at one end in bacteria (Fig. 5, *c*).

FIG. 6.

FIG. 6.—PLATE WITH PULPS FROM HUMAN TEETH. *a*, after treatment with oil of cinnamon; *b*, with bichloride of mercury; *c*, with borax; *d*, with campho-phenique; *e*, with oil of peppermint. *a* and *b* have remained sterile; the others are surrounded by a more or less extensive growth of bacteria.

7. *Sulphate of Copper.*

Sulphate of copper has a powerful penetrative and preservative action. The pulps soon become stiff, light green in color, and have a sour, metallic smell. Transferred to agar-agar, they mostly remained sterile (Fig. 4, *b*). Next to bichloride of mercury, it is perhaps the most efficient preservative which we have; unfortunately, it also badly discolors the teeth.

8. *Borax.*

Although borax appears to permeate the substance of the pulp very rapidly, its antiseptic action is correspondingly weak. The majority of the pulps treated with it showed evident signs of putrefaction in a very short time, some of them completely liquefying, giving off at the same time an exceedingly disagreeable odor. Occasionally, under appli-

cation of large doses, they were tolerably well preserved, but on the whole the results were such that I should never think of using it in the treatment of diseased teeth. (See Fig. 5, *d*.)

9. *Boric Acid.*

The results obtained by boric acid were very similar to those of borax.

Fig. 7.

Fig. 7.—Agar-Agar Plate with Four Pulps. *a*, treated with oil of cinnamon, and *b*, with carbolic acid, have remained comparatively free from bacteritic growths; *d*, treated with methyl-violet, and *c*, with methyleneblue, are completely overgrown.

10. *Ethereal Oils.*

The oils of peppermint, wintergreen, and eucalyptus gave at once results so little encouraging (Fig. 6) that but few experiments were made. I shall, however, make further tests with them. Oil of cloves appeared somewhat better. The best results, however, were obtained with *oil of cinnamon*. This oil permeates and stiffens the tissue with tolerable rapidity, tinging it various shades of yellow to brown. Pulps treated with it, placed upon the nutritive plates, proved to be sterile in a large measure (Figs. 6, 7, and 8). I am at present in doubt whether to place the oil of cinnamon on a level with trichlorphenol and carbolic acid; further experiments will be necessary to settle this question.

11. *The Double Cyanide of Mercury and Zinc,*

recommended by Lister in the treatment of wounds, applied in the form of powder, appeared to penetrate the pulp to a distance of one-quarter to one-half an inch. It utterly failed to preserve any considerable portion of the pulp from decomposition.

FIG. 8.

FIG. 8.—AGAR-AGAR PLATE CONTAINING: *a*, two pulps treated with borax; *b*, one with sublimate; *c*, two with carbolic acid; *d*, one with oil of cinnamon; *e*, one with iodoform. *b* has remained completely sterile; *c* and *d* are partially, *a* and *e* totally overgrown with masses of bacteria.

12. *α- and β-Naphthol*

applied in concentrated alcoholic solutions, manifested an evident conserving action; it was, however, so manifestly inferior to that of bichloride of mercury, carbolic acid, oil of cinnamon, etc., that I should never think of using these agents in practice. (See Fig. 4, *a*.)

13. *Hydronaphthol*

showed considerable penetrating, antiseptic, and consequently preservative action. I cannot say, however, that I was as well pleased with it on the whole as I have been with some other substances, or have received any incentive to use it in practice. Further experiments with this agent are necessary to enable me to come to a definite conclusion.

14. *Trichlorphenol.*

Trichlorphenol ($C_6H_2Cl_3OH$), formed by conducting chlorine into carbolic acid (phenol), occurs in form of white crystals, which liquefy

at 65° C. It has a strong, irritating odor, but its escharotic action, as far as I have observed by a simple test on the skin, seemed less than that of phenol. Its antiseptic power has been said to be twenty-five times as great as that of phenol. This is very probably a great mistake. It possesses the property of penetrating pulp-tissue very rapidly, thoroughly hardening it and imparting to it a beautiful pink to red color. It also exerts a powerful antiseptic action, so that in its pulp-preserving property I think I may put it by the side of the sulphate of copper, although carbolic acid, chloride of zinc, and oil of cinnamon will compete with it for the place.

15. *Carbolic Acid (Phenol).*

Carbolic acid gave results so similar to those obtained with trichlorphenol that they need not be especially described. Its action appears on the whole not quite as powerful as that of trichlorphenol.

16. *Chloride of Zinc.*

Chloride of zinc penetrates the tissue quite as rapidly, and in some cases it has appeared even more rapidly than sublimate. Applied on cotton to the end of a pulp one and a half inches long, it will permeate the whole pulp in forty-eight hours, converting it into a grayish-white stiff body.

Such pulps transferred to the agar-agar plates very seldom showed any development of bacteria, except at the extreme point.

The antiseptic power of the chloride of zinc is, however, known to be inferior to that of many other available antiseptics, so that, on the whole, I am not yet sure where this agent should be placed on the list; this will be determined by further experiments. It certainly has thus far produced a very favorable impression.

17. *Thymol and Salicylic Acid*

manifested an evident preservative action upon the dental pulp; it was, however, very decidedly inferior to that of those substances just discussed, and usually confined to a small portion of the pulp. Of the two, thymol gave the better results, though I should not make use of it in practice, since we have so much better agents at our disposition.

Basic Aniline Coloring-Matters.

Of these substances, recently so highly recommended by Prof. Stilling for the treatment of wounds, obstinate ulcers, etc., under the action of which they disappear with almost magic quickness, only two have been tested, *Methylviolet* and *Methyleneblue*. Neither of these substances has the slightest preservative action, nor did they penetrate the pulps to a depth of more than a quarter of an inch. Pulps treated with either the pure substance or with the concentrated alcoholic solu-

tion soon showed signs of putrefaction, and became enveloped in a growth of bacteria when transferred to the agar plate (Fig. 7, *c*, *d*).

Campho-phenique.

This antiseptic has scarcely been tested often enough to admit of forming a proper estimate of its value. It appears to penetrate the tissue about as rapidly as carbolic acid, producing a delicate pale color and moderately hardening the tissue. The pulp also acquires antiseptic properties by the absorption of the solution, but not, as far as my experiments have shown as yet, equal to that imparted to the pulp by carbolic acid alone.

I have at present a large number of other antiseptics under observation, the value of which I can estimate only approximately. Of these, the cyanide of mercury appears quite equal to the bichloride in its permeating and preserving action; resorcin, thallin, sulphocarbolate of zinc, oil of birch, acetico-tartrate of aluminium, etc., all show sufficient action to encourage further investigation of them, while eucalyptus oil, iodol, tincture of iodine, spirits of camphor, naphthaline, and some others showed so little action that I shall not consider them further. The antiseptics which I have thus far experimented with may accordingly be arranged in the following classes:

1. *Those pre-eminently active in preventing decomposition of pulp-tissue:*

Bichloride of mercury, cyanide of mercury (?), trichlorphenol, sulphate of copper, phenol (carbolic acid), oil of cinnamon, chloride of zinc, campho-phenique (?), hydronaphthol (?).

2. *Those of doubtful value:*

Thymol, salicylic acid, eugenol, α- and β-naphthol, acetico-tartrate of aluminium, 5 per cent. solution of bichloride of mercury, and possibly some essential oils.

3. *Those nearly or quite worthless:*

Iodoform, basic aniline coloring-matters, borax, boracic acid, chloride of lime, peroxide of hydrogen, sozoiodol salts, iodol, tincture of iodine, spirits of camphor, naphthaline, the double cyanide of mercury and zinc, and many essential oils.

Resorcin, thallin, sulphocarbolate of zinc, oil of birch, iodide of sodium, nitrite of sodium, and some other substances have not yet been sufficiently tested to permit of forming an estimate of their value, though some of them seem to promise well.

The reader should not attempt to form an estimate of the value of any particular antiseptic from an examination of anyone of the plates illustrated above. It is sometimes necessary to study numbers of such plates before a definite conclusion may be arrived at.

I wish, in conclusion, to call attention only to a subject which I shall present more fully at another time, viz, the unstability of antiseptic compounds. Many labor under the supposition that an antiseptic placed in the cavity of a tooth or in a root-canal and sealed in with a water-tight substance remains unchanged and retains its antiseptic action indefinitely. This, I fear, is a great mistake.

Some substances act only in virtue of their own dissolution, and in the same degree as they act they lose the power to act further and eventually become completely inert. Peroxide of hydrogen is a well-known example of this class. It cannot act without giving up its extra atom of oxygen, and in doing so it becomes simply water, an inert substance. Now, without having made a thorough study of this question, I am convinced that a similar loss of power is suffered by nearly all if not all antiseptics in the course of time. I have found that threads of cotton saturated with concentrated carbolic acid and brought into root-canals some months or even weeks later had completely lost their antiseptic action ; particularly was this the case where there was a large open foramen. Which of the antiseptics otherwise adapted to the treatment of diseased teeth retains its antiseptic action for the greatest length of time, is a subject well worth a thorough investigation. Antiseptics applied to cavities of decay on cotton naturally retain their power but a few hours. Pledgets of cotton saturated with carbolic acid and placed in large cavities near the gums were found not only to have lost their antiseptic action in twenty-four hours, but when placed on sterile plates of agar-agar they became the center of an extensive bacteritic growth.